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SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-AB-2001-039**
R.A. Ahmad, B.A. Laubacher (Thiokol), "Evaluating Solid Boost Demonstrator Motor Specific Impulse Performance" (Abstract)

Kelly Klein, 054

AIAA/ASME/SAE/ASEE Joint Propulsion Conference
(8-11 Jul 2001, Salt Lake City, UT) (Deadline: ?)

(Statement A)

Evaluating Solid Boost Demonstrator Motor Specific Impulse Performance

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The Integrated High Payoff Rocket Propulsion Technology (IHPRPT) Phase 1 Solid Boost Demonstrator (Boost Demo) motor was fabricated as the Phase 1 Demonstration of technologies from the ~~(IHPRPT) program~~. This motor incorporates new technologies in an attempt to increase delivered performance compared with the IHPRPT Baseline motor. The IHPRPT Baseline motor and Boost Demo nozzle motor aft and nozzle contours are compared in Fig.1.

While the Boost Demo has a de-submerged nozzle, it contains an "eyebrow" feature designed to reduce the amount of slag trapped/observed in the nozzle split line region of the SICBM motor. It contains a circumferential cavity upstream of the nozzle throat. Slag entrapment may jeopardize the motor if it solidifies and inhibits nozzle vectoring.

Two-dimensional axisymmetric steady-state computational fluid dynamics (CFD) simulations have shown the following. First, flow separation and re-attachment upstream and downstream of the cavity opening, respectively. Second, vortices developed in the cavity. Third, small size alumina particles (10 microns in diameter) have followed the gas streamlines without entrapment in the cavity. Larger size particles, ~~of~~ 100 microns in diameter, also followed the gas streamlines with channeling effect; i.e. along and in the vicinity of the centerline.

Calculations have been identified to assess the discrepancies between measured and predicted I_{sp} losses in the Boost Demo motor test on November 16, 2000. Three geometries will be considered initially: The IHPRPT baseline motor with a submerged nozzle, and Boost Demo with and without the eyebrow feature. These three cases will allow comparison of the eyebrow, submergence and de-submergence effects. The eyebrow may affect performance as follows. First, vortices develop in the cavity that would enlarge as the cavity insulation erodes. Second, flow separation and re-attachment upstream and downstream of the cavity opening would disturb the flow field. Third, vortex shedding could also be unsteady; starting at the cavity lip and impinging upstream of the nozzle throat. Furthermore, circumferential flow may develop when the nozzle is vectored.

You're using future- and past-tense verbs. Please describe what did happen and what will happen in sequence.

The effect of nozzle exit cone erosion on Isp will be also analyzed. Then ? profile of the eroded nozzle exit cone was obtained from hot firing test.

Two burn times will be analyzed for each geometry: initial and the late in-burn after the aft-end propellant has burned-out. An eroded nozzle will be analyzed. Additional characterization of the flow/particle impingement and slag accretion environments will be conducted to assess additional Isp loss factors.

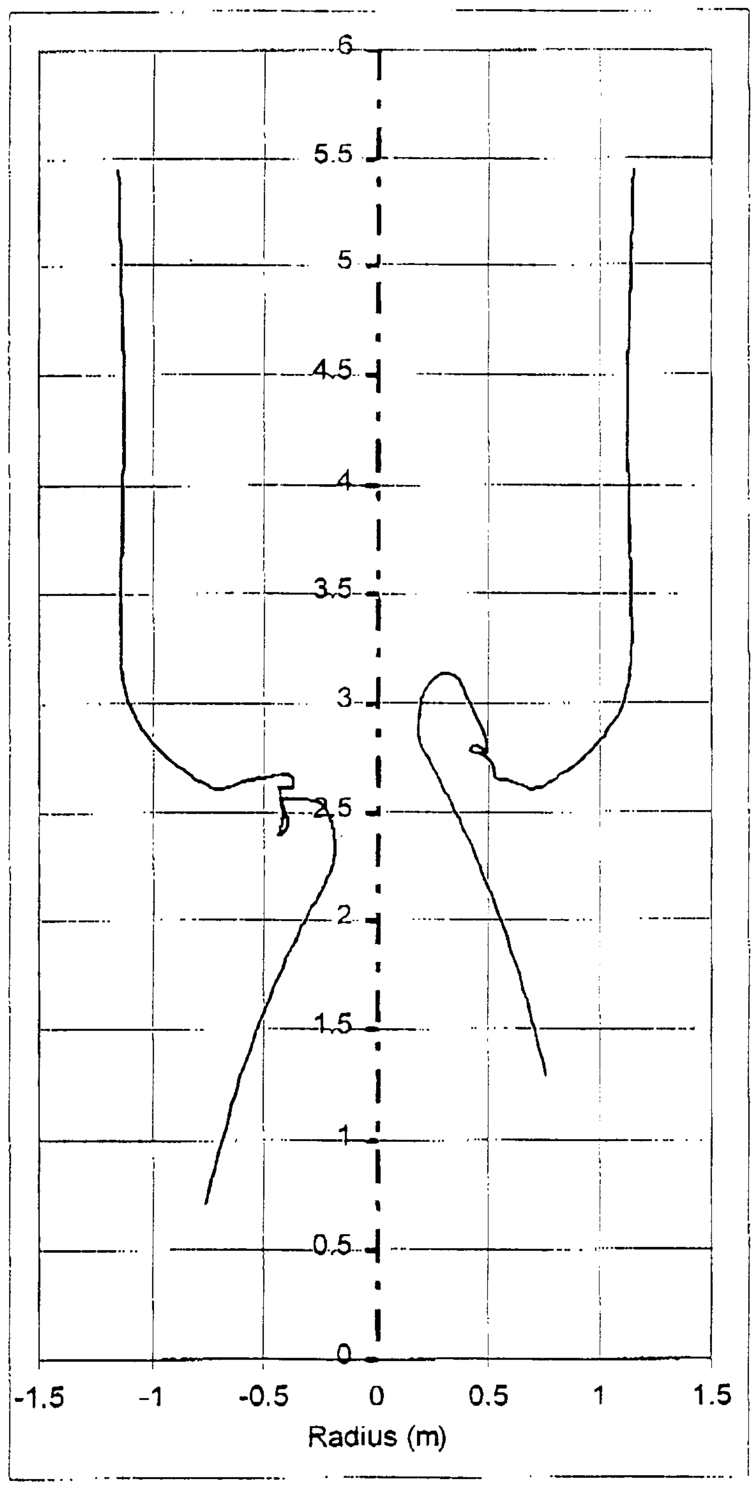

Fig. 1 IHPRPT Baseline and Boost Demo nozzle motor aft nozzle contours